

USFWS INVOLVEMENT

The U.S. Fish and Wildlife Service's involvement at RMA began when bald eagles were found on-site in 1986. Despite contamination in the core areas, the relatively undisturbed and largely uncontaminated buffer zone around the core production areas provided food, shelter, and freedom from human disturbance for the eagles and nearly 300 other wildlife species at RMA.

In 1987, the Service began managing the site's abundant wildlife as remediation went forward. As required by the 1992 RMA National Wildlife

Lake Mary is part of the National Wildlife Refuge area and the center of public recreational activities at the Arsenal.



Refuge Act, USFWS is responsible for managing and mitigating the impacts of remediation on the Refuge's wildlife. The USFWS also provides opportunities for visitors to learn about the site's diverse wildlife, unique history, and active environmental remediation.

The goals and vision of USFWS for

the Refuge were released in June 1996, in a Comprehensive Management Plan that outlines Refuge development. While simultaneously supporting the environmental remediation and sustaining wildlife and their habitats, the plan allows for public use of the Refuge through community outreach, tours, and educational programs.

PUBLIC USE AND ENVIRONMENTAL EDUCATION

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Document Locations

**Joint Administrative Record and
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Rocky Mountain Arsenal, Building 129
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Monday - Friday 12 - 4 p.m.
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(303) 289-0362

EPA Superfund Records Center
999 18th Street
Denver, CO 80202
303-312-6473
Monday - Friday 8 - 4 p.m.

RMA was first opened to public recreational visits in 1989. Weekday and weekend visitation took place until October 2000, when the first of ten GB bomblets was discovered in Section 36 of the RMA. After the discovery of the bomblets, the RMA was closed to visitors until October 2002. Since then, access has been limited to weekends only.

Visitor safety is a top priority. Since the site is undergoing active cleanup, visitor access is carefully controlled and visitors participate in guided tours and special events, or are restricted to the Visitor Center and trails. On Fridays, after weekly cleanup work is completed, site conditions are reviewed to determine any issues that might affect visitation activities. In addition, staff and volunteers guide or oversee all visitor programs; and ensure that extensive safety procedures are in place.

The RMA has hosted nearly 9,000 adults and 3,000 children since it reopened in October 2002. One of the most popular activities at the RMA is catch-and-release fishing,

which has been available to visitors since 1990. The Refuge sport-fishing program shows a catch rate of greater than one fish per hour during the past ten years, and includes trophy-size game fish. Lakes designated for fishing are Lakes Mary and Ladora, where largemouth bass, channel catfish, crappie, bluegill, perch, and northern pike, may be found.

Other events on weekends include: hiking, guided bike tours, bird watching, nature programs, photo tours, and guided tram tours.

The RMA also sponsors a fishing program for patients of Children's Hospital, and Craig Hospital, which specializes in rehabilitation and research for patients with spinal cord and traumatic brain injury. Volunteers teach fishing skills to these visitors on Friday afternoons, after work has stopped for the week.

Once remediation is complete, scheduled for 2011, and the remaining portions of the site transferred, RMA will become one of the largest urban wildlife Refuges in the U.S.



FACT SHEET
Rocky Mountain Arsenal
PAST, PRESENT, FUTURE June 2004

HISTORICAL OVERVIEW

The Rocky Mountain Arsenal (RMA) Federal Facility Site is located in Commerce City, Colorado, approximately 10 miles northeast of downtown Denver. RMA was established on 17,000 acres of farmland in early 1942, immediately following America's entry into World War II (WWII).

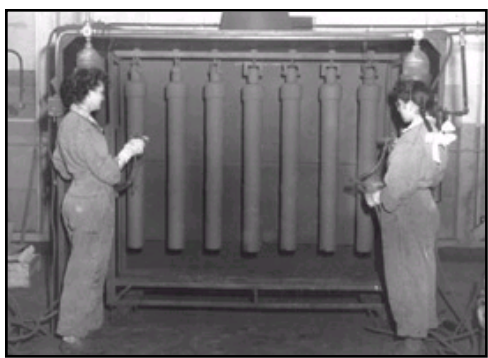
The U.S. Army manufactured chemical and incendiary munitions (mustard gas, napalm, white phosphorus) at the South Plants complex at RMA throughout WWII. Following the war, to foster economic growth in the area, offset operational costs and maintain the facilities for national security, private industry was encouraged to lease facilities at RMA. Under this program, Julius Hyman and Company began producing pesticides in 1946. In 1952, Shell Chemical Company acquired Hyman and continued to produce agricultural pesticides on-site until 1982. Pesticide manufacturing included chlorinated hydrocarbon, organophosphate, and carbamate pesticides, herbicides, and soil fumigants. The Army continued the production and processing of munitions and other military materiel after WWII ended.

Incendiary and antipersonnel munitions manufactured at RMA were used in Korea in the early 1950s, and in Vietnam in the

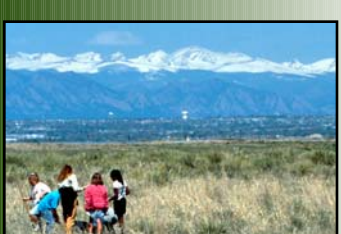
late 1960s. Between 1950 and 1952, the Army constructed the North Plants manufacturing complex to produce nerve gas agents and RMA became the free world's primary producer of Sarin (GB) during the 1950s. The Army demilitarized obsolete and deteriorating WWII-era munitions throughout the 1950s and 1960s and, from the 1950s through the 1980s, the Army used the North Plants facilities to demilitarize a wide variety of items including munitions containing GB, the nerve agent VX, phosgene, and Adamsite (a riot-control agent), as well as chemical agent identification kits. In addition, the Army operated an Air Force-owned hydrazine-blending and storage facility adjacent to the South

Plants from the 1960s through the early 1980s. Rocket fuel for the Titan and Delta rockets, and JPX aviation jet fuel were blended at RMA.

A wide range and large volume of feed-stock chemicals, munitions, and manufacturing waste products were stored, handled, or disposed at RMA during its operational life. Both solid and liquid waste streams required increasingly complex and sophisticated disposal solutions, but by 1984 the environmental impacts of the operations and resulting waste-streams at RMA had become so pronounced that all private and military manufacturing and demilitarization operations were stopped.



With many men sent overseas to fight in World War II, women were recruited by the Army to produce chemical weapons for the war.



WASTE HANDLING

Wastes generated during the production years at RMA were disposed of using accepted practices of the time. Solid wastes were disposed on-site in burn pits, sanitary landfills, and disposal trenches. The Army and Shell shared an incinerator to decontaminate and destroy contaminated wastes between 1966 and 1970, but discontinued its use due to particulate emission concerns.

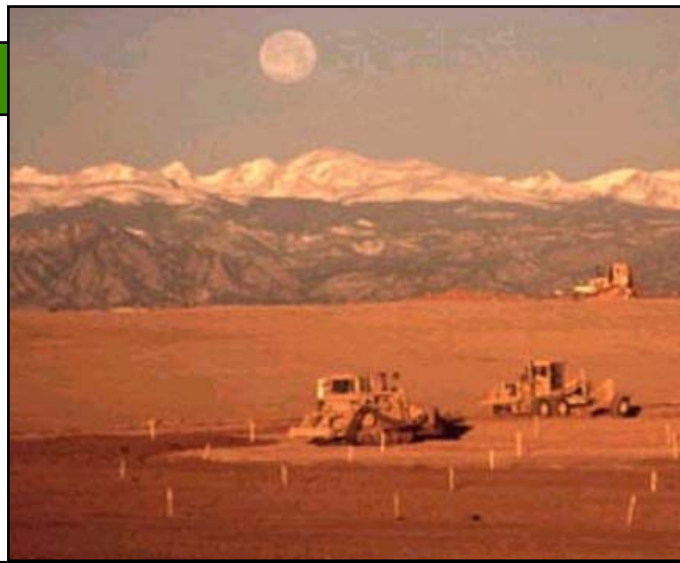
Initially, liquid wastes from the South Plants complex were treated with caustic and discharged into the Basin A area in Section 36, north of South Plants, where they could evaporate or seep into the ground, or were discharged to drainage ditches that flowed into the natural stream drainage system in the area.

In 1946, overflow from Basin A was channeled into Basin B. In 1953, Basin C was constructed to hold all liquid waste from South Plants, as well as overflow from Basin A. Also during that year all liquid waste streams were diverted from the natural stream system to additional overflow basins D and E.



An environmental engineer tests a well for groundwater contamination.

Cleanup efforts in 1989 at Basin F, which was built in 1956 as an evaporation pond to store liquid wastes.



Efforts to contain liquid wastes and prevent seepage into the ground began in the mid-1950s; soon after the discovery that contaminated groundwater

In 1961 the Army embarked on a program to permanently dispose and isolate all liquid wastes from the environment.

was causing damage to well-water irrigated crops located north of RMA, approximately 2½ miles from Basin A. In 1956, the Army built Basin F, an evaporation pond designed to store all liquid wastes. Believed to be the first of its kind in the country, the 93-acre, asphalt-lined pond was capable of holding 243 million gallons of contaminated liquid.

In 1957, waves damaged the asphalt liner in Basin F, and Basins A and C were used to temporarily store the liquid from Basin F while the liner was repaired. With this exception, Basin F was the only basin used for liquid waste disposal after 1956.

In 1961, the Army embarked on a program to permanently dispose and isolate all liquid wastes from the environment. An injection well was drilled 12,000 ft deep into the

Precambrian rocks beneath Basin F, and in 1962 the Army began to inject liquid wastes into the well. A total of more than 165,000,000 gallons (625,000 cubic meters) of liquid wastes were disposed in the deep injection well, but in 1966 injections were permanently halted after a series of unusual earthquakes centered in the RMA area were shown to correlate with the fluid injection history at the deep well.

Both the Army and Shell continued to send liquid wastes to Basin F in the 1970s, but both also explored other solutions to their respective waste-stream problems. The Army operated a spray-dryer system in North Plants in 1973 and 1974 to dry liquid wastes associated with GB demilitarization activities, and drummed the resulting solid waste for off-site disposal.

However, this operation was halted due to excessive energy consumption, and the wastes were subsequently treated with a sodium hydroxide solution and discharged to Basin F. Shell constructed an effluent treatment system in 1975 to treat all the aqueous wastes originating from their South Plants manufacturing activities. The system was effective, but by 1978 the volume of waste exceeded its capacity, and liquid wastes had to be temporarily stored in tanks for disposal off-post.

CLEANUP ACTIONS

To date, all remediation projects for the Off-Post areas have been completed, with the exception of the continuing groundwater treatment and attenuation. With input from the community, a comprehensive schedule for the on-post RMA cleanup was developed with an "outside-in" approach that would increase the buffer area around ongoing cleanup activities in the central core area and take advantage of EPA's new guidance that allowed for deletion of portions of a site from the NPL.

The On-Post ROD was divided into 31 major projects for coordination and design, and has been implemented in 74 separate phases of work.

On-Post remediation projects have been completed for the perimeter areas. In the Central Remediation Area, contami-

nated soil excavation operations have been completed at all the former disposal basins except Basin F, where removal of the double-lined waste pile and placement of the final cover remain to be done, and the Lime Basins. The South Plants have been demolished and the debris and soils disposed at the HWL or Basin A. North Plants has also been demolished and similarly disposed. The Hex Pit and the M-1 Pits projects were excavated and placed in the HWL in 2003 and 2001, respectively. All four sanitary landfills in Sections 1, 4, 30 and 36 have been excavated. The lake sediment remediation, Northern Tier, and Southern Tier soil remediation projects were completed in 2000. The Toxic Storage Yards were completed in 2000 and the slurry walls installed around the Complex (Army) and Shell trenches in 2001.

SARIN BOMBLETS

As cleanup progressed smoothly at RMA, few people had reason to recall the site's WWII and Cold War purpose as a chemical weapons manufacturing plant. But in October 2000, that changed. During routine cleanup of a fenced and secured scrap yard in Section 36 as part of the Miscellaneous Structures Demolition Project, Army contractors found a grapefruit-sized M-139 bomblet filled with Sarin (GB). In mid-November, five more M-139 bomblets containing Sarin were discovered. In December, after Colorado's Governor met with the commander of the U.S. Army Materiel Command and reviewed five disposal options, the Governor and his staff selected a new, airtight, explosive device technology that had been successfully tested to destroy GB just two weeks earlier.

In late January and early February 2001, the six bomblets were safely and successfully destroyed. By June 2001

the scrap yard investigation was completed, and four additional bomblets had been discovered, each containing GB. The same device used to destroy the first set of bomblets was deployed to RMA again, and the second set of bomblets was destroyed in late July 2001.

All visitor tours were cancelled and the visitor program suspended for two years while the ten M-139 bomblets were destroyed, all related investigations and cleanup activities finished, and an evaluation of the potential for any subsequent discovery of such munitions was completed.



Sarin bomblet

DELETIONS FROM THE NPL



Nearly 300 species of animals, including mammals, amphibians, reptiles, fish, and birds such as burrowing owls (above), live at the Arsenal Wildlife Refuge. Major efforts have been made during Arsenal cleanup activities to preserve and restore plants, lakes, wetlands, and other features that provide wildlife habitat.

In January 2003, the Western Tier Parcel consisting of 940 acres (380 hectares) along the western side of RMA was deleted from the NPL. Sale of the Western Tier Parcel to Commerce City is expected in June 2004. These funds will be transferred to USFWS to build a new visitor and education center at the Refuge. Institutional controls prohibit residential, industrial, and agricultural uses of the Western Tier Parcel. Commerce City has developed a conceptual plan that focuses on 'green' businesses that are compatible with the adjacent Refuge.

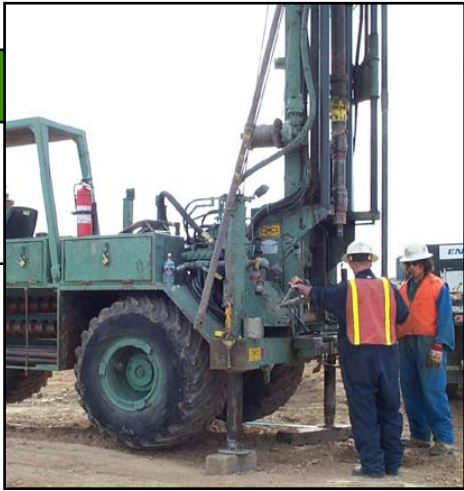
One year later, the Selected Perimeter and Surface Deletion Areas comprising approximately 5,053 acres (2,045 hectares) were deleted from the NPL and transferred to USFWS. With that deletion and transfer, the Rocky Mountain Arsenal National Wildlife Refuge officially came into existence.

FUNDING OF RESPONSE ACTIONS

The FFA includes a Settlement Agreement between the United States and Shell Oil Company that establishes a process for allocation and payment of costs for the Response Actions, provides for payment by the Army and Shell of costs incurred by other federal agencies at the Arsenal, and payment of costs for residual Natural Resource Damages (NRD) resulting from releases of hazardous substances at or from the Arsenal. For the first \$500,000,000 of costs

Technicians drill soil core samples to test for contaminants as part of cleanup activities at RMA.

incurred, the Army and Shell divided the costs evenly (50%-50%). For costs greater than \$500 million but less than \$750 million, the Army paid 65 percent and Shell paid 35 percent. For all costs greater than \$750 million, the Army pays 80 percent and Shell contributes 20 percent. The pri-



mary exception to this allocation approach occurs when the presence of contaminants is due solely to the activities of either Shell or the Army. When this occurs, then the entity to whom the contamination is attributed pays 100 percent of the associated Response Costs.

Response Costs incurred by EPA, primarily for oversight of remedy implementation, are reimbursed annually prior to expenses being incurred. These payments are to continue until EPA provides certification that the final Response Action has been completed.

The State of Colorado was not initially a signatory to the FFA and receives reimbursement of Response Costs, also for oversight of remedy implementation, after expenditures have been incurred. Payment to the Agency for Toxic Substances and Disease Registry was provided as compensation for the conduct of a Health Assessment or Health Effects Study. Payment to the Department of Interior was provided for their participation in the Response Actions at RMA as well as NRD assessment(s).

Natural resource damages are negotiated between the Army, DOI, Shell, and the State to determine the extent of and the amount of monetary compensation necessary for injury to, destruction of, or loss of natural resources attributable to releases from RMA.

CHEMICAL WEAPONS CONVENTION TREATY

RMA was a principal component of the United State's chemical weapons production facilities, and the destruction of these facilities at RMA represents a major milestone accomplishment in fulfilling the obligations of the Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction, otherwise known as the Chemical Weapons Convention (CWC) treaty. Originally a bilateral agreement between the USA and the



With many men sent overseas to fight in World War II, woman were recruited by the Army to produce chemical weapons for the war.

USSR, the CWC became an international treaty following the collapse of the Soviet Union. The United States ratified the CWC on April 25, 1997, and it entered into force two days later. As of March 29, 2003, 176 countries have signed the CWC, and 151 have ratified its terms and principles.

Four declared sites existed at RMA: the HD (mustard) Fill Facility and the HD (mustard) Distillation Facility, both in former South Plants; and the Dichloro Production facility and the GB Production and Fill Facility, both in former North Plants. All four have been dismantled and destroyed, and RMA's Program Manager received certification on the official closure of the final declared facility from the Director General of the Organization for the Prohibition of Chemical Weapons in October 2003.

The destruction of these facilities at RMA represents the elimination of 60 percent of the United States' former chemical weapons manufacturing capacity and was completed two years ahead of the treaty deadline.

ENVIRONMENTAL ISSUES

In the 1970s, due to heightened environmental awareness among the general public, the concern with the crop damages reported by farmers down-gradient of RMA, and the discovery of DIMP (a by-product of GB manufacturing and demilitarization) and DCPD (used in pesticide manufacturing) in surface waters north of the Arsenal, the Army and Shell began a systematic investigation into the contamination problems. Beginning in 1974, the Army established a Contamination Control Program at RMA to ensure compliance with federal environmental laws, and began a series of environmental investigations. These investigations revealed that contamination was concentrated mainly in alluvial sediments and alluvial groundwater, and outlined contaminant sources and migration pathways.

On the basis of this information, Interim Response Actions (IRAs)

Technicians work at groundwater monitoring wells.



were designed to protect on- and off-site human health and the environment from RMA pollution.

Ultimately 14 IRAs were undertaken, including construction and operation of six groundwater treatment systems responsible for treating over 1 billion gallons of groundwater each year. These six systems include one off site north of the Arsenal (operational in 1993), three along the north, northwest, and west boundaries (operational in 1976, 1984, and 1981, respectively), one north of Basin F that went online in 1990, and one

north of Basin A that also became operational in 1990. In 1975, the State of Colorado issued three Cease-and-Desist orders to the Army and/or Shell. These administrative orders were based on the Colorado Water Quality Control Act, passed in 1973, and directed Shell and the Army to immediately stop the off-post discharge of DIMP and DCPD in surface and subsurface water. Two lawsuits were filed in 1983 as a result of contamination at RMA. The first was filed by the US Department of Justice on behalf of the Army against Shell for reimbursement of environmental response costs and for damages to the natural resources at RMA. The second was filed by the State of Colorado on behalf of the Colorado Department of Public Health and the Environment (CDPHE) against Shell and the Army for both on- and off-site environmental damages.

In 1984, RMA was proposed to the Environmental Protection Agency's (EPA) National Priorities List (NPL) and the Army initiated full-scale remedial investigations (RIs). RMA was listed on the NPL in 1987 without Basin F which, since 1986 to the present, has been regulated by the Colorado Hazardous Waste Management Act under interim status. In 1989, Basin F was added to the NPL as well. That same year, Basin F was drained and excavated as an IRA. The liquids were subsequently incinerated in a submerged-quench incinerator, and the soil and sludge was contained in a double-lined, above-ground waste pile.

REGULATORY FRAMEWORK

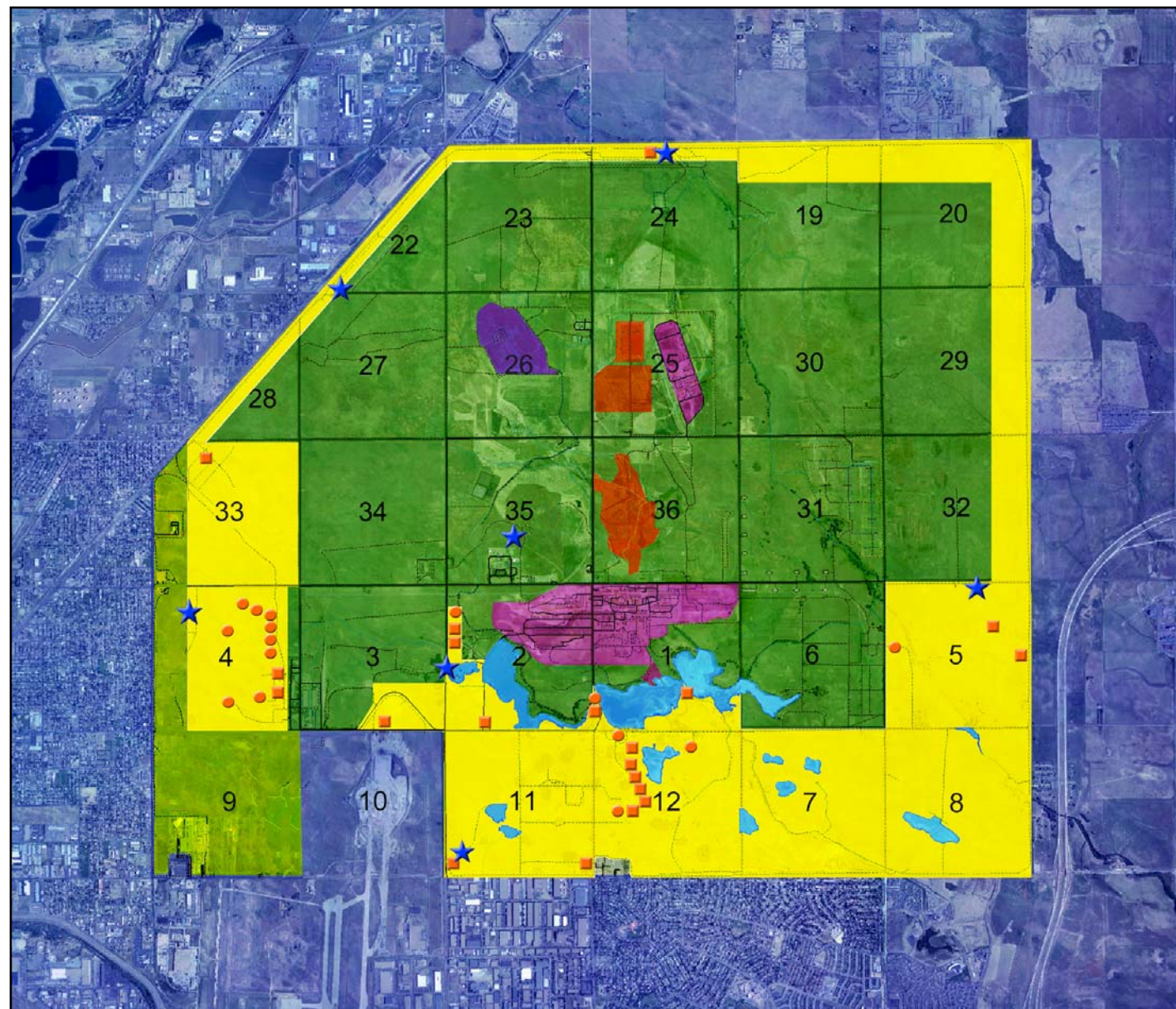
In a practical sense, the lawsuits were resolved through entry of a Consent Decree, known as the RMA Federal Facility Agreement (FFA), with the court in 1989. Signatories included the Army, Shell, EPA, the U.S. Department of the Interior (DOI), and the Agency for Toxic Substances and Disease Registry. As part of the FFA, the Army and Shell agreed to implement response actions that comply with the 1980 Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, otherwise known as 'Superfund'), and with all applicable regulations, laws and agreements. Though not a signatory to the FFA, the State declared its intention to utilize the FFA in a good-faith effort to resolve all issues informally, while reserving any

rights and authorities it may have.

In 1986, a winter communal roost of bald eagles an endangered species was discovered on-site. Soon thereafter, it was determined that close to 300 wildlife species inhabit RMA including deer, coyotes and owls. The FFA incorporated this significant change by identifying the end goal of the RMA cleanup to be beneficial public use and preservation of wildlife habitat.

Later, in recognition of the abundant wildlife, the Rocky Mountain Arsenal National Wildlife Refuge Act was signed into law (1992) creating a national wildlife refuge from the RMA site following EPA certification that required remedial response actions have been completed.

Rocky Mountain Arsenal Site



- Denver Metro Area**
- National Wildlife Refuge** (deletion area)
- Western Tier Parcel**
- RMA NPL Site** (exclusive of offpost area)
- On-Post Landfills** (Hazardous Waste Landfill, Enhanced Landfill, and Basin A)
- Former Manufacturing Areas** (North and South Plants)
- Basin F**
- Air Monitoring Stations** (perimeter)
- Soil Remediation Projects completed in the deletion area**
- Structures Remediation Projects completed in the deletion area**
- Section Numbers**



NATURE AND EXTENT OF CONTAMINATION

An RI, endangerment assessment, and feasibility study were completed in 1995, providing information on the type and extent of contamination, potential human and ecological risks, and remedial actions for cleanup. Contamination was found at 181 soil sites and in 15 groundwater contaminant plumes. Over 600 chemical contaminants were identified, of which 70 were the principle focus of the remedial investigations and 27 were determined to be "contaminants of concern" based on the risk they posed to human health.

Soil contaminant sites requiring reme-

A technician tests a soil sample.

dial actions were organized into four categories: (1) Potential Unexploded Ordnance; (2) Potential Agent Presence; (3) Biota Risk; and (4) Human Health Exceedance. Most contaminants were located within 5 feet of the ground surface, though at a few sites contamination was deeper. The most contaminated sites were concentrated in the central six sections of RMA, including Section 36, once referred to as the "most contaminated square mile on earth."

Soil sites included disposal pits and lagoons, the former liquid-waste stor-



age basins, landfills, burial trenches, munitions testing areas, burn pits, ditches, chemical and sanitary sewer lines, stream and lakebed sediments, spill areas, and surficial soils (less than 6 inches deep).

Fifteen plumes of groundwater contaminants were identified, comprising 5 distinct "plume groups". With the exception of the Western Plume Group, all originate in the central portion of RMA. Principal groundwater contaminants include volatile organics and chlorinated hydrocarbons, organochlorine pesticides, DIMP, arsenic, chloride, fluoride, and sulfate.

Contaminants were also identified in structures, biota, and the air at RMA. Some of the structures without any potential exposure risk from contaminants were designated as Future Use. The remainder, and structures with significant-contamination, agent-contamination, or other-contamination history were designated as No Future Use. Most structures were slated for demolition, including all those in the South and North Plants.

Contaminants have been detected in some wildlife at RMA, primarily in habitat near former production facilities, and the US Fish and Wildlife Service (USFWS) continues to monitor the effects of cleanup actions on sensitive species. Additionally, because air contamination depends on specific activities that may cause releases, air quality is monitored continuously during remedial activities, and these activities are designed and controlled to prevent unacceptable impacts to air quality.

SELECTED REMEDY

In 1995, intensive public involvement helped the Army, Shell, USFWS, CDPHE, and EPA reach two monumental decisions: the Off-Post Record of Decision (ROD) signed December 19, 1995, and the On-Post ROD signed June 11, 1996.

These RODs provided the framework, purpose, and rationale for the RMA remedy. The On-Post ROD required: (1) Interception and treatment of contaminated groundwater at three existing on-site treatment plants; (2) Construction of a new, double-lined, hazardous waste landfill (HWL) meeting all regulatory requirements to contain human health exceedance soils and structural debris with significant- or agent-contamination history; (3) Consolidation of biota risk soil and structural debris with other contamination history in former Basin A; (4) Demolition of structures with no designated future use and disposal of the debris in either the new HWL or the Basin A consolidation area; (5) Construction of covers, caps, and biota barriers, and installation of slurry walls, to contain and isolate contaminated soils not selected for excavation and containment at either the HWL or Basin A; and (6)

Construction of a new, triple-lined, enhanced hazardous waste landfill (ELF) to contain soils and sludge excavated from Basin F and currently contained in the Basin F Waste Pile. The On-Post ROD also provided for private wells within the footprint of the DIMP groundwater plume north of RMA to be connected to a public water supply, and the purchase of 4,000 acre-feet of potable water to be added to the public water supply. In accordance with the 1992 Refuge Act, the Army will retain all waste containment facilities and water treatment plants for as long as they are required for the remedy.

The Off-Post ROD required: (1) Interception and treatment of contaminated groundwater at the existing off-post treatment plant; (2) Closure of poorly constructed wells that could be acting as migration pathways for contaminants from the shallow to the deeper aquifer; (3) Tilling and revegetation of about 160 acres of soil; (4) Natural attenuation of inorganic chloride and sulfate groundwater plumes; and (5) Institutional controls, including deed restriction on Shell-owned property, to prevent the use of groundwater exceeding remediation goals.